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تأثير التغيرات المناخية على تصريف الاودية جنوب شرق العراق باستخدام الطرق الاحصائية والاستشعار عن بعد (*RS*) ونظم المعلومات الجغرافية(*GIS*)

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قسم الجغرافية/الكلية التربوية المفتوحة /مركز واسط الدراسي
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المستخلص:
تعد ظاهرة التغير المناخي ظاهرة طبيعية تحدث كل عدة آلاف من السنين، ولقد تسببت زيادة الأنشطة البشرية إلى تسارع حدوث التغير المناخي. وبما أن المناخ هو متوسط الأحوال الجوية المتعاقبة في مكان ما لفترة طويلة فقد تكون شهراً أو موسماً أو سنة أو عدة سنوات. لذلك نجد أن علم المناخ يهتم بإظهار متوسط أو متوسط الأحوال الجوية السائدة في منطقة ما بدلا من إظهار التغيرات اليومية للأحوال الجوية في المنطقة. يعتبر علم المناخ من العوامل الطبيعية المؤثرة في تكوين سطح الأرض وفي مختلف جوانب الحياة النباتية والحيوانية والإنسانية. كما يهتم علم المناخ بالتطبيقات العلمية لتحديد أنماط الظروف الجوية وتفسيرها وإمكانية استخدامها لصالح الإنسان.ولقد تناولت الدراسة اثر التغيرات المناخية على موجات السيول في اودية شرق العراق على مدى ٢٢ سنة اي دورتين مناخيتين صغرى لتظهر التذبذبات والتغيرات المناخية واثرها على موجات السيول باستخدام الطرائق الاحصائية وبرامجGIS ,RS
الكلمات المفتاحية:تغيير المناخ،العناصر المناخية، احواض المياه.

The impact of climate change on the drainage of valleys in southeastern Iraq using statistical methods, remote sensing(RS) and geographic information systems(GIS),

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Abstract:

Climate change is a natural phenomenon that occurs every few thousand years, and the increase in human activities has accelerated the occurrence of climate change. Since climate is the average of successive weather conditions in a place for a long period, it may be a month, a season, a year or several years. Therefore, we find that climatology is concerned with showing the average or mean weather conditions prevailing in a region rather than showing daily changes in weather conditions in the region. Climatology is considered one of the natural factors affecting the formation of the Earth's surface and various aspects of plant, animal and human life. Climatology is also concerned with scientific applications to determine patterns of weather conditions, interpret them and the possibility of using them for the benefit of humans. The study addressed the effect of climate change on flood waves in the valleys of eastern Iraq over a period of 22 years, i.e. two minor climate cycles, to show climate fluctuations and change and their effect on flood waves using statistical methods and GIS and RS programs.

Keywords: climate change, climatic elements, basins of water networks,

1. Introduction

The study area is located within steep climatic gradients in rain, precipitation, and temperatures. Map (1)(2), especially with the recent climatic changes witnessed by the earth, which is rising from oceanic regions to continental regions (Katilaand, , 2018 pp7,8) is estimated as the average The global temperature varies between 0.99 ± 0.13 degrees Celsius above the baseline prior to the beginning of the industrial revolution, and the added pollutants contributed to raising temperatures in the years (1850-1900), and thus affected other climatic factors, including the intensity of rain. 2018 is the warmest year ever, ranging from 2013 to 2018. (WMO, 2019, P6) The concept of climate change has been linked to the period in which volatility, change, fluctuation, or change prevails. For example, the change includes most of the surface of the earth. In order to know the tendency of the climate towards drought, humidity, cold, or warmth, it takes place during a period. A disturbance occurs in the hydrological system

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(Upset Hydrology), where the state of water and its path in its surface and underground stores change and thus change the patterns of rainfall and the occurrence of floods, droughts, and the flow of rivers As the water disappeared in many places where it was present and appeared in places where it was not, and with the increase in temperature, the activity in the gaseous atmosphere increases, causing the formation of clouds and storms that are very turbulent due to the intensity of evaporation. (Saidi, 2015, pp. 201, 375) Two centuries ago, the northern hemisphere was passing through an early snow age, and before the last thousand years within the Middle Ages, the study area was going through a warm era, while the interest more than a decade ago was concerned with global cold. (**Sahib**, **2008, pp. 16-17).** The GISARCMAP10.7 and RS programs were used to detect the effect of surface climate elements on climate changes over the years. Remote sensing is widely used in hydrological and hydrogeological studies in monitoring the drought of lands, the drying up of lakes, monitoring desertification and land degradation, in addition to dealing with expected floods and torrents by comparing images taken over periods; the relationship of climate change to periods of drought. Capture and extract data that the human eye cannot capture Due to the sensitivity of the naked eye to visible rays. It takes standard procedures with great speed and accuracy regarding heights, slopes, areas, etc., helps people conduct applied studies related to the branches of geography, and enables them to draw maps and update them with the finest details as quickly as possible. For Maps: Geographers benefit from drawing and preparing maps based on aerial and satellite images. It also helps to keep updating old maps with accuracy and enriching them with helpful information.

1.1 Related Work

Modern digital software and statistical methods have been relied upon, and previous studies have been updated, such as Study 15. Ahmed Lafta Hamad Al-Budairi, indicators of climate change and their impact on increasing drought manifestations in the province of Babylon, Department of Geography, College of Education, University of Baghdad Ibn Rushd, 2012. 10. Ablain, M. et al.: Satellite altimetry-based sea level at global and

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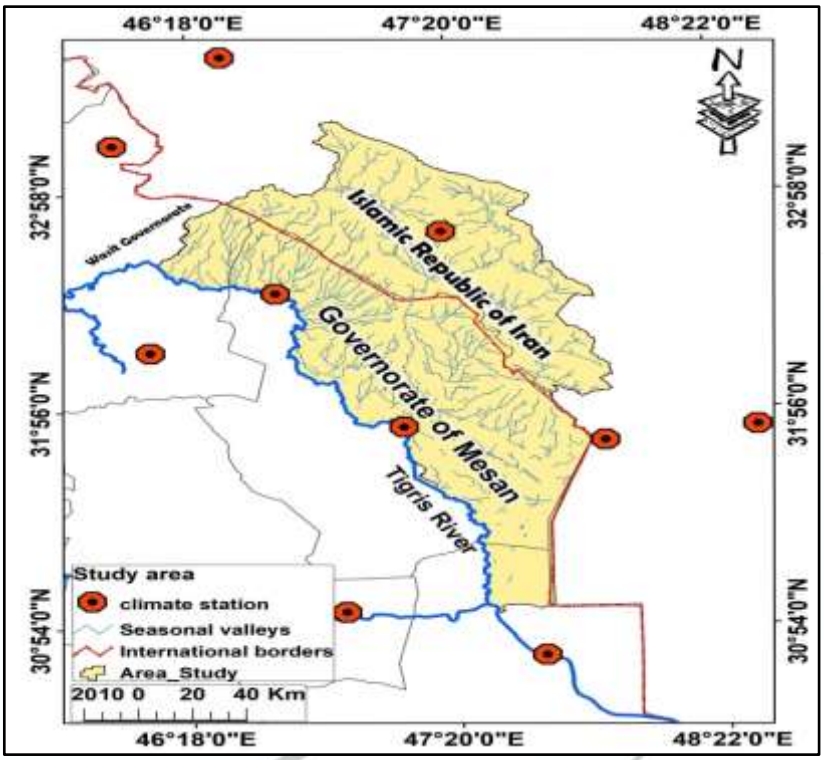
regional scales. Surveys in Geophysics, 2017. **The location of the study area,** Study area stations map(1)(2)

Map (1) The Study area stations map



Source/researcher's work based on GIS ArcMap 10.8.RS

Map (1) The location of the study area

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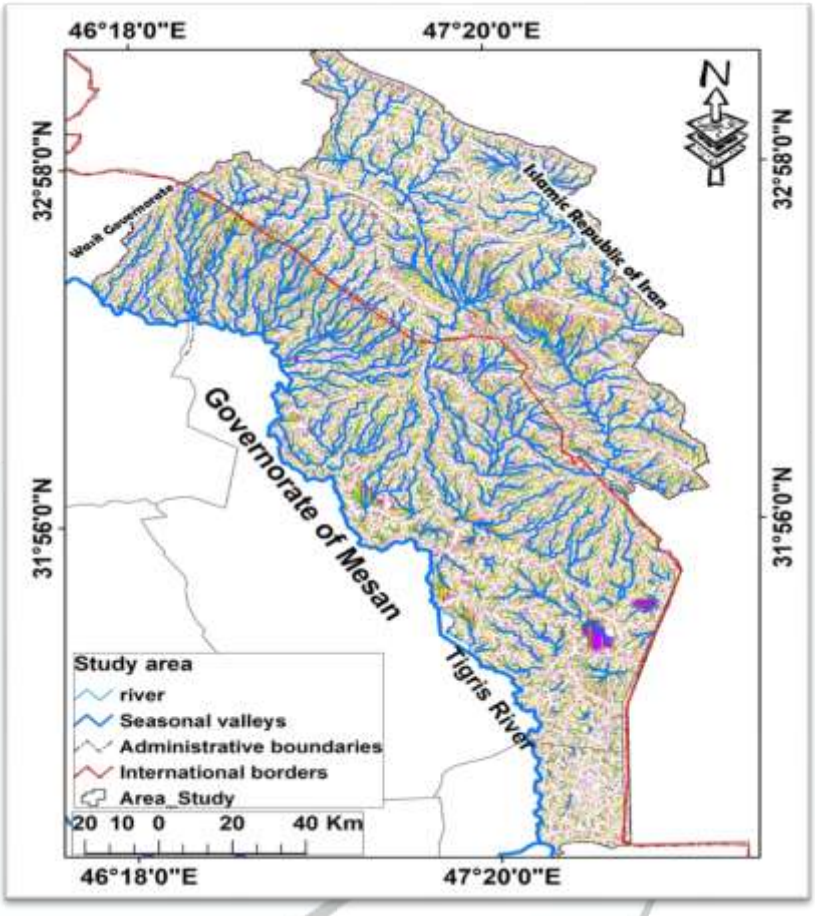

Source/researcher's work based on GIS ArcMap 10.8.RS

Since the study area, due to global warming, went through periods of drought, the focus was placed on periods of positive rainfall, which are as follows:

1-2 Proposed Methodology

The analytical descriptive approach was used using statistical methods and modern digital programs

1-3/ Global temperature change

The year 2013 is equivalent to 2007 as the sixth warmest year recorded since 1850, as the global average temperature in it was 0.50, and the average value in 2011-2012 was 0.43 degrees Celsius, 0.46 degrees Celsius. However, they witnessed the conditions of the cooling La Nina, which is one of the main drivers Due to the natural variability in the climate system, unlike the years 2010 and 1998, which were considered among the warmest years due to the phenomenon of the Southern Oscillation. According to the

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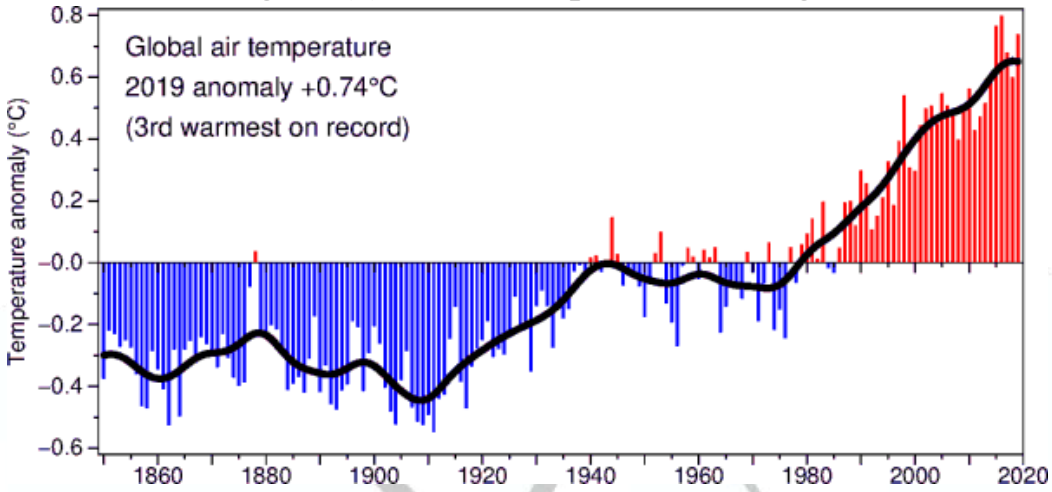
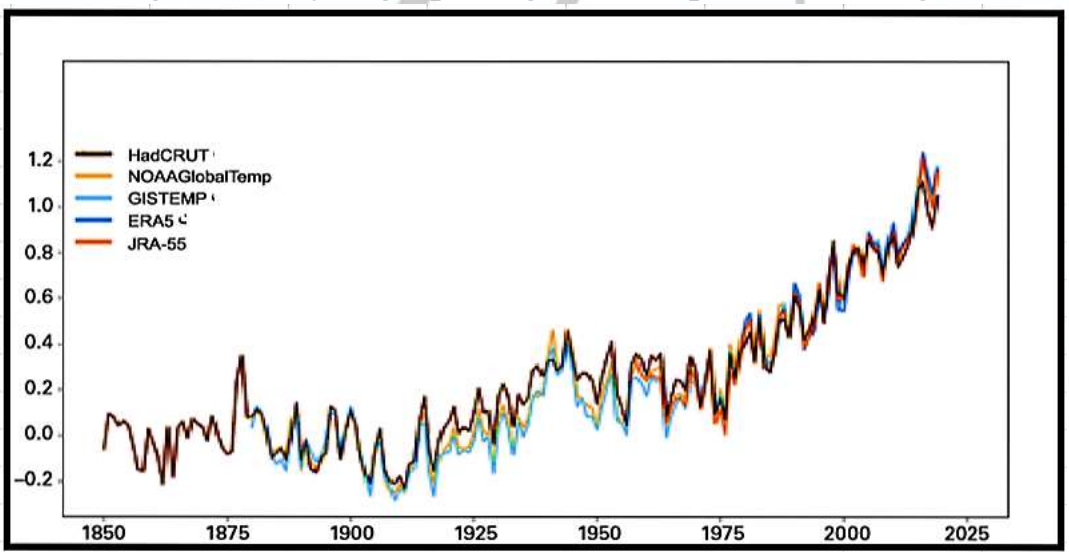
IPCC report, the temperatures were above the levels of the industrial era between 0.8-1.2 for 2017-2018, and the warming likely increases every year between 0.1-0.3 degrees Celsius. See Figures (1), (2), (3).

Figure (1) Global temperature change



Source/cru.uea.ac.uk.edu, Climatic Research Unit, Unversity of East Anglia / http://www.cru.uea.ac.uk/

Figure (2) Hyetograph of global temperature change



Source/ WMO Statement on the State of the Climate in 2019, WMO Publication No. 1248, p. 6.

Figure (3) Projections of the surface temperature increase from 1000 years to 2100

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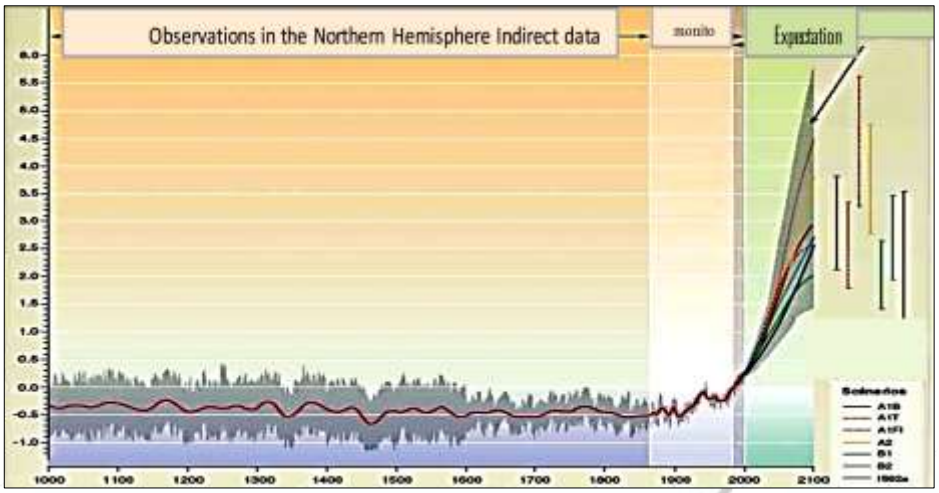

Source: N. Nakicenovic, IPCC Special Report on Emissions Scenarios, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2000, P 599.

1-4/ rain and snow.

Rain occurs in the study area due to the formation of atmospheric depressions, primarily in the rainy seasons. These air depressions arise as a result of the presence of a strong temperature gradient between the higher and lower offers, as the depressions work to transfer and exchange shots between these offers, and with the increase in temperatures, the thermal differences increase, causing a change in the systems Rain or displacement, and to clarify this, global precipitation during 2013 averaged the period 1961-1990 of 1033 mm, according to the National Oceanic and Atmospheric Administration NOAA. More rainy conditions were seen in the Arabian Peninsula than average; as for snowfall, climate change caused snow accumulation from 10-15 January. The first is because of rare snow storms that hit the Middle East, and temperatures dropped to less than -16 degrees Celsius (WMO, 2013, pp. 4,6,8)

The Islamic Republic was also affected in 2018-2019 by devastating floods in late March and early April, reaching over 24 hours 188 mm. Most countries in that year were exposed to similar conditions, which indicates that the cause of torrential rains and floods is the increase in global warming, which . Changes the climate trends towards extremes, anomalies, or the occurrence of heat or cold waves ("International Disaster Database," 2021) and the organization has monitored the activity of more than 72 tropical cyclones in the northern hemisphere compared to the average of 59. Rain

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with climatic changes, as for climatic systems, the study area due to climate change from 1994-2001 took a decreasing trend in the Mediterranean, Icelandic, Sudanese, and integrated depressions, while it was found that the Indian and Arabian Peninsula depressions have taken a trend of increasing, which reduced the precipitation amounts in the region The study (A.Ghalis , 2011, pp107-108).but then it was exposed to frequent extra-tropical systems between the years 2013-2018, which caused extreme rain, strong winds and frequent severe storms that brought rain over 24 hours of more than 200 mm and an increase in the activity of other depressions) (WMO., , pp. 6, 9, 18, 2019). To measure the intensity of rain, the World Meteorological Organization did not rely on simple monthly and annual averages. However, it has developed many indicators that provide additional information, including weather measures. Consecutive wet days (CWDs) give the longest rainfall during the days in a certain period, and (the RX5) scale records the highest rainfall rate over five days. The Arabian Peninsula, as the rains caused sudden floods in late October and November as the amount of rain exceeded 84 mm within 6 hours due to the occurrence of an atmospheric depression centered on the Mediterranean Sea, which led to floods and strong winds in 2018 (WMO, p. 22, 2018)

1-5/ sea level

Water level rise The sea level continued to rise, so the global average sea level reached its highest value since the beginning of the altimetry record, estimated at (3.24) +/- (0.3) due to the increased loss of ice sheets as well as the increase in precipitation due to warming) (M. Ablain, , PP 38, 2017) seen Figure (4)

Figure (4) The mean direction of sea level

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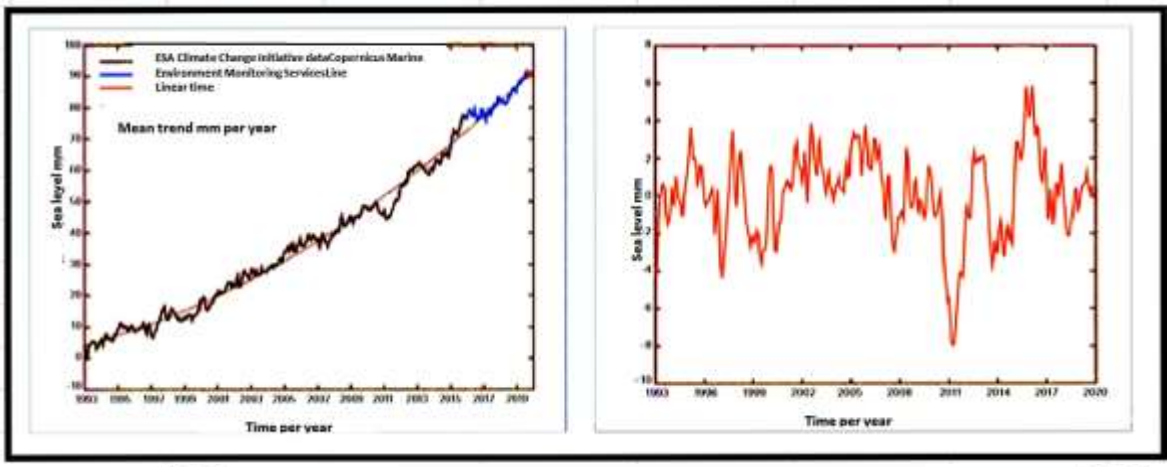

Source/ WMO Statement on the State of the Climate in 2019, WMO Publication No. 1248, p. 12.

1-6/Sinks of carbon dioxide, methane, and nitrous oxide

Our planet keeps warm due to the greenhouse effect (energy retention) instead of leaving it outside the gaseous atmosphere and dissipating it in space. This regulatory mechanism assigns gases with very weak concentrations to achieve the climatic balance of the planet, as carbon dioxide gas before the industrial revolution ranged from 270 parts per million (UN, PP. 12,13, 2013.)With the increase in human activity, the rate of carbon dioxide increase increased, and the increase in terrestrial and oceanic carbon dioxide sinks continued in response to the increasing concentrations of carbon dioxide in the atmosphere. Land and ocean sinks of carbon dioxide increased 45 percent of all anthropogenic carbon dioxide emissions (WMO, PPP. 9, 25, 29, 2017) ,increasing by 405.5ppm +/-0.1PPM and methane 1859. +/-2ppb PPD, and nitrous oxide 329.9+/-0.1ppb PPD for 1750 (Friedlingstein. (2019) [Online]. https://doi.org/10.5194/essd-11-1783

1-7/ Indicators of changes in climatic elements and water flows in the study area

To know the impact of the non-climate between 1996-2018 for 23 years, which represents two minor cycles for the study area, we adopted the statistical method, which is a method used to predict the climatic changes of some elements of the climate, especially the temperatures in the past and the search for a certain regularity in its path, which is called the time curve For those elements if a particular curve of temperature behavior is found during the period, the future is expected. (T. Mahmoud, , pp. 390-391,2019)

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c = annual rate of change
bi = trend coefficient
Y = arithmetic mean
We extract bi from the following equation:
bi=
Since:-
X2-X1 = the difference between the two means
T2-T1 = the difference between the two times
(Al-Budairi.and ,2012). (Ibrahim, Statistical, p. 102, 1999).

1-8/ Deviation from average in actual and theoretical brightness

It is clear from Table (1) that the actual solar brightness took a decreasing trend during the study period in all stations. The decreasing rates of the actual solar brightness ranged between (8% and 16%) to clarify the time changes in solar brightness, the general trend of the series was calculated. Figure (5) shows a downward trend, and we note a decrease in actual solar brightness in all study stations, indicating a decrease in actual solar brightness. and figure (5)

Table (1) The rate of change and deviation of the actual and theoretical solar brightness (hour/day) for stations

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Theoretical number of hours of brightness						
station	General directions to the stations during the recording period	Average Hours of Brightness	The number of years	rend coefficien	f change for th	(%) Annual rate of change
Al-HAI	1996-2018	11.2	23	0.0231-	4.74375-	0.20625-
AL-AMARA		10.8	23	0.0334-	7.11296-	0.30926-
Ali Al Gharbi		10.9	23	0.0346-	7.30092-	0.31743-
BEDRA		11.4	23	0.0204-	4.11579-	0.17895-
Nasiriyah		11.1	23	0.0351-	7.27297-	0.31622-
Basra Al Hussein		11.6	23	0.0521-	10.3302-	0.44914-
ELAM		10.3	23	0.0378-	8.44078-	0.36699-
DezPHul		10.4	23	0.0082-	1.81346-	0.07885-
BOstan		10.1	23	0.029-	6.60396-	0.28713-
Dehlran		10.6	23	0.0636-	13.8-	0.6-

Actual brightness hours					
station	Average Hours of Brightness	The number of years	trend coefficient	ate of change for the st	(%) Annual rate of change (%) Annual
Al-HAI	7.8	23	0.0303-	8.93462-	0.38846-
AL-AMARA	7.5	23	0.0439-	13.4627-	0.58533-
Ali Al Gharbi	7.2	23	0.0388-	12.3944-	0.53889-
BEDRA	7.4	23	0.026-	8.08108-	0.35135-
Nasiriyah	7.2	23	0.051	16.29167	0.708333
Basra Al Hussein	7.7	23	0.0375-	11.2013-	0.48701-
ELAM	7	23	0.0032	1.051429	0.045714
DezPHul	7.4	23	0.0398-	12.3703-	0.53784-
BOstan	7.7	23	0.0397	11.85844	0.515584
Dehlran	7.3	23	0.02	6.30137	0.273973

Source: The researcher's work is based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Surface data for a program RS.

Figure (5) The general trend of the change in the number of hours of actual and theoretical brightness

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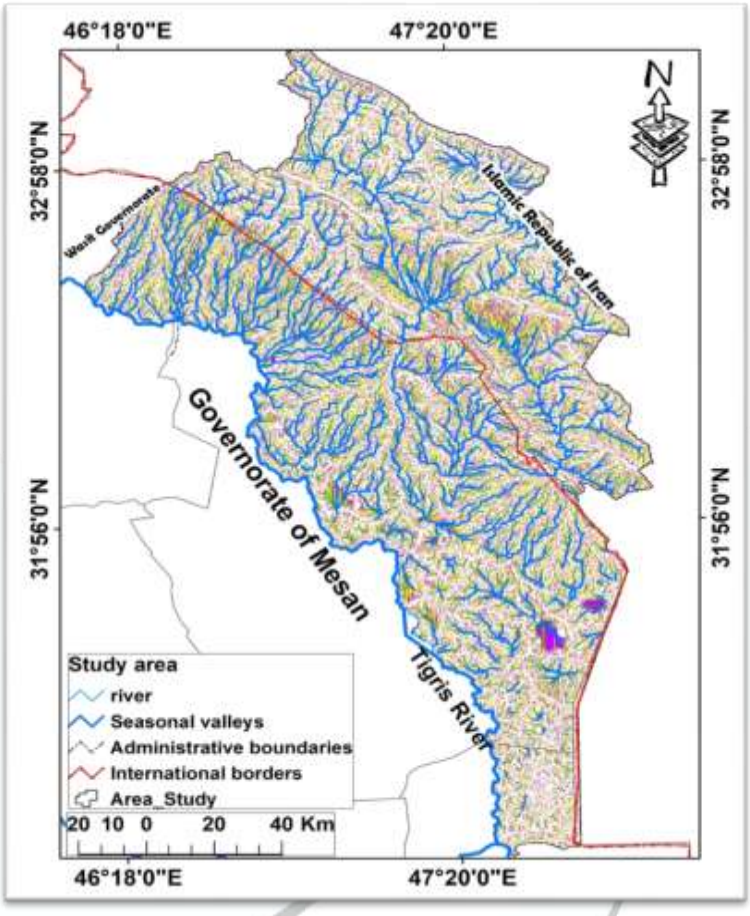

Source/researcher's work based on GIS ArcMap 10.8.RS

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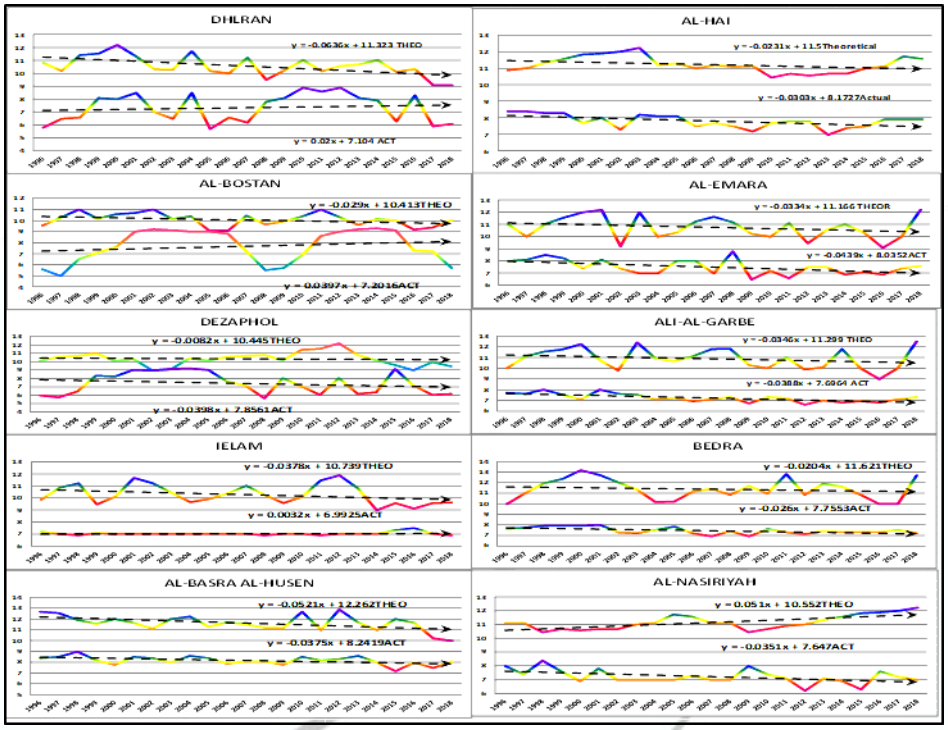
years due to the phenomenon of the Southern Oscillation. According to the IPCC report, the temperatures were above the levels of the industrial era between 0.8-1.2 for 2017-2018, and the warming likely increases every year between 0.1-0.3 degrees Celsius. See Figures (1), (2), (3).

Figure (1) Global temperature change



Source: The researcher's work, based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Table (1) Surface data for a program RS

Map (2) the general trend in the number of hours of actual brightness in the study area

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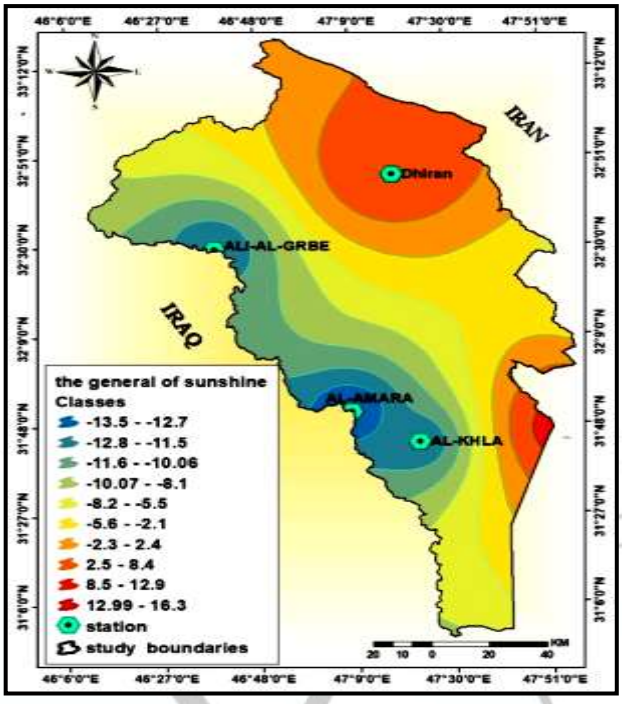

Source/researcher's work based on GIS Arc Map 10.8, Table (1) Surface data for a program RS

1-9/ Change index for temperature

It is evident from Table (2) that the average annual temperatures have taken an increasing trend in most stations of the study area, and the rates of increase ranged between (0.4% and 8.4%) except for the Hay and DahLran stations. We calculated the general trend to clarify the time changes in the normal temperatures. For the time series Figure (7), we noted that the temperature had risen in all study stations, indicating that the normal temperature was higher than the normal rate. See Table (2), Map (3), and Figure (6), (7)

Table (2) The rate of change in the normal temperatures of the study stations for the period (1996-2019).

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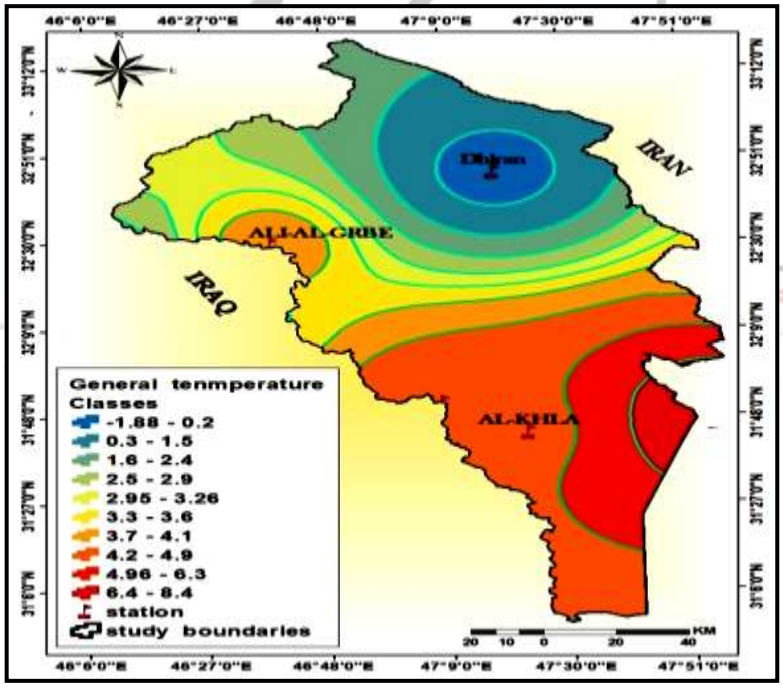
station	Average normal temperatures	The number of years	trend coefficient	The rate of change for the study (%) period	Annual rate of change (%)
Al-HAI	20.5	23	0.017-	-1.888	0.082-
AL-AMARA	20.3	23	0.0421	4.77	0.207
Ali Al Gharbi	20	23	0.0347	3.985	0.173
BEDRA	19.5	23	0.0421	4.966	0.216
Nasiriyah	21.2	23	0.0471	5.11	0.222
Basra Al Hussein	21.6	23	0.0264	2.811	0.122
ELAM	11.6	23	0.0018	0.357	0.016
DezPHul	19.1	23	0.0287	3.458	0.15
BOstan	20	23	0.0729	8.384	0.365
Dehlran	21.1	22	-0.004	-0.447	-0.019

Source: The researcher's work is based on the General Authority for Air and Seismic Monitoring, Climate Section, Baghdad, 2021 (unpublished data). Surface data for a program RS(3) The rate of change in the regular temperature of the study duration (1996-2019).



Source / Research Work on GIS ArcMap 10.8, Table (2) Surface data for a program RS

Figure (6)) The rate of change in the regular temperature for the duration of the study (1996-2019)

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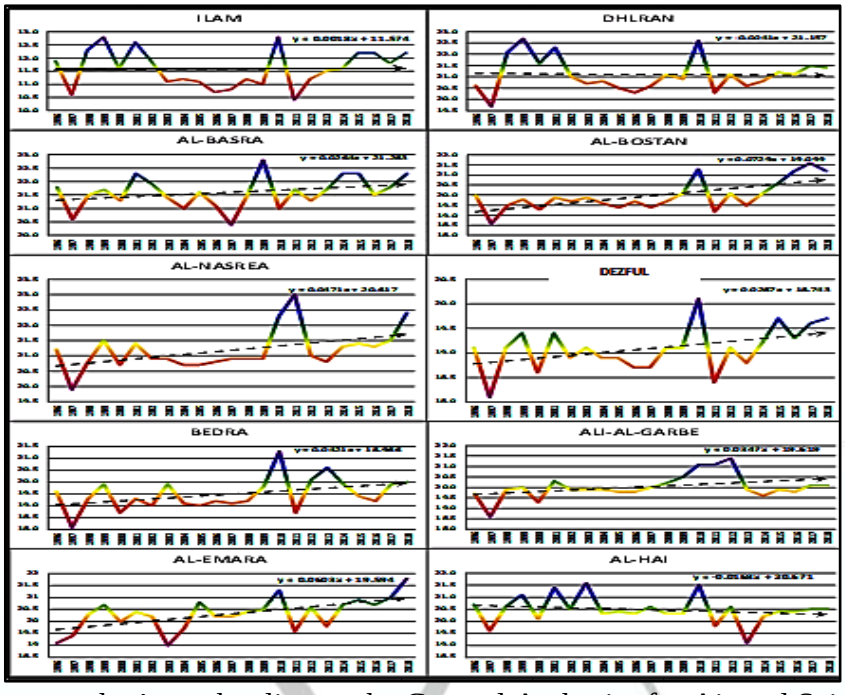
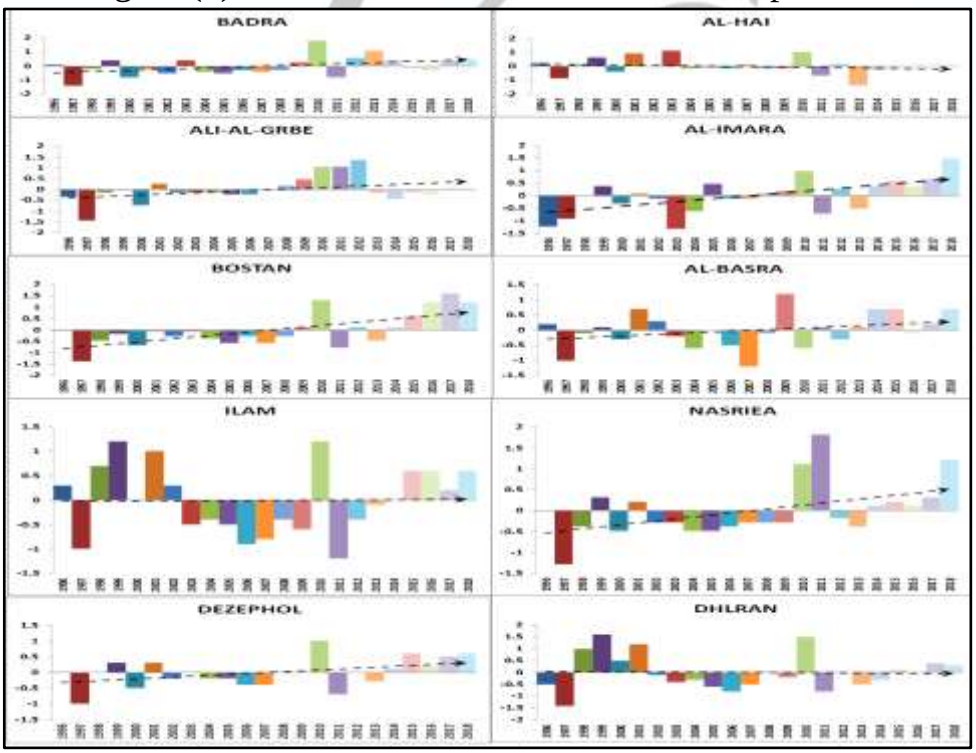


Source: The researcher's work relies on the General Authority for Air and Seismic Monitoring, Climate Section, Baghdad, 2021 (unpublished data). Surface data for a program RS.

Figure (7) annual deviation ** for normal temperature



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Source: The researcher's work relies on the General Authority for Air and Seismic Monitoring, Climate Section, Baghdad, 2021 (unpublished data). Surface data for a program RS.

1-10 micro-temperatures

The trend of micro-temperatures was increasing during the duration of the study in most stations and increased rates between 0.5% and 20.8%), except for Basra and Badra, and to illustrate the time changes to the micro-temperature Calculation of the general trend of the time series and is illustrated by Figure (8) A trend towards the rise in all school plants, a table (3) and a map (4), (8),

Table (3) The rate of change in micro-temperature for the duration of the study (1996-2019).

station	The average minimum temperature rate m o	The number of years	trend coefficient	(%) The rate of change for the study period	(%) Annual rate of change
Al-HAI	14.3	23	0.0229	3.6832	0.1601
AL-AMARA	14.4	23	0.0362	5.7638	0.2506
Ali Al Gharbi	13.7	23	0.0518	8.6964	0.3781
BEDRA	13	23	-0.009	-1.6631	-0.0723
Nasiriyah	14.5	23	0.045	7.1379	0.3103
Basra Al Hussein	15.3	23	-0.0121	-1.8190	-0.0791
ELAM	0.2	23	0.071-	817.65-	35.55-
DezPHul	6.8	23	0.0388	13.1235	0.5706
BOstan	6.8	23	0.0615	20.8015	0.9044
Dehlran	9.3	23	0.0021	0.5194	0.0226

Source: The researcher's work is based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Surface data for a program RS.

Map (4) The rate of change in the minimum temperatures of the study stations for the period (1996 - 2019)

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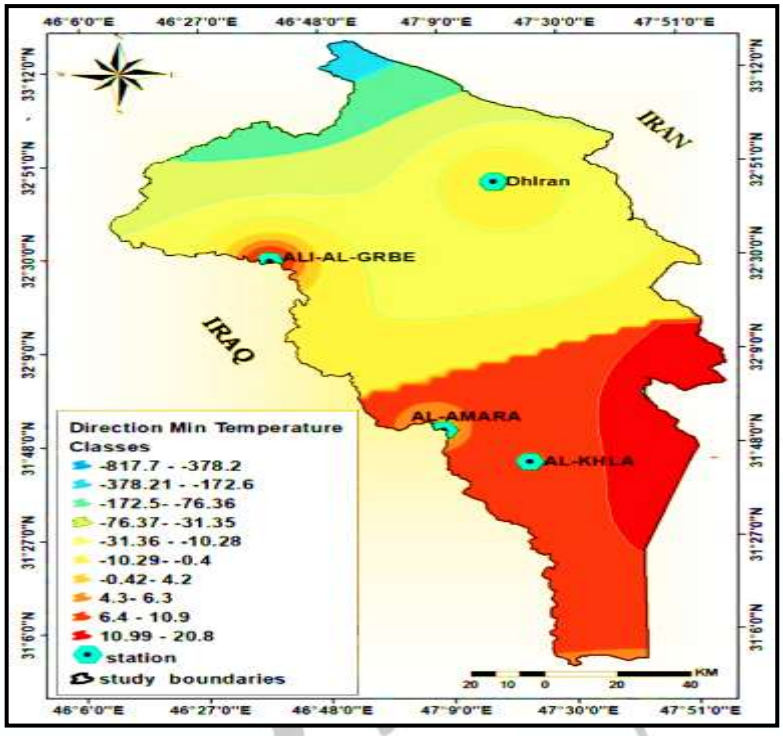

Source/researcher's work based on GIS Arc Map 10.8, table (3) Surface data for a program RS

Figure (8) The rate of change in the minimum temperatures of the study stations for the period (1996-2019)

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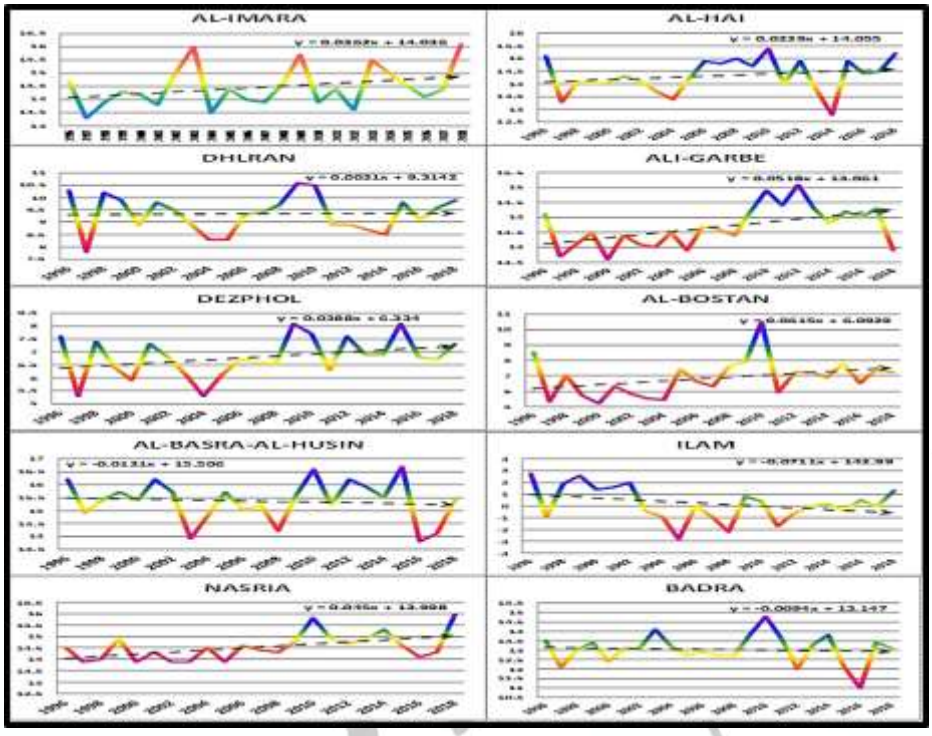
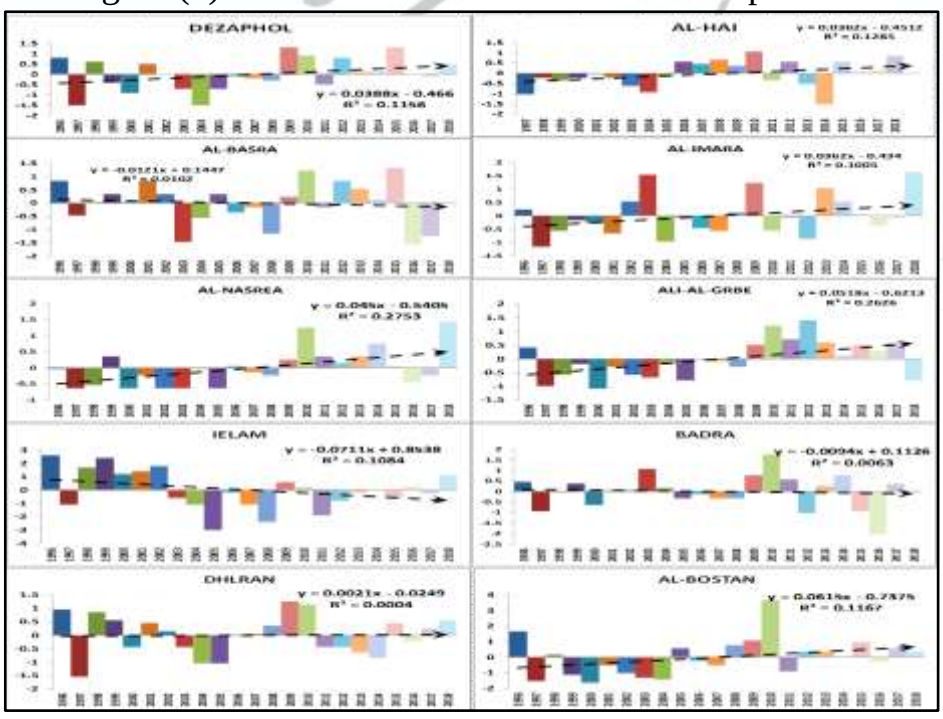


Source: The researcher's work is based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Table (3) Surface data for a program RS.

Figure (9) Annual deviation of minimum temperature



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Source: The researcher's work is based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). table(3) Surface data for a program RS

1-11/ Maximum temperatures

It is evident from Table (4) that the average annual maximum temperatures took an increasing trend in all study stations. The rates of increase ranged between (+7.2 and +1.1) except for the neighborhood station, and to clarify the time changes of maximum temperatures, the general trend was calculated for the time series Figure (11), which indicates an upward trend, see Table (4), Map (5), and Figure (10), (11)

Table (4): the rate of change in the maximum temperatures of the study stations for the period (1996-2019).

station	Average maximum temperature	The number of years	trend coefficient	(%) The rate of change for the study period	(%) Annual rate of change
Al-HAI	27	23	0.021-	1.78889-	0.07778-
AL-AMARA	27.3	23	0.0293	2.4685	0.10733
Ali Al Gharbi	26.78	23	0.0337	2.8943	0.12584
BEDRA	26.2	23	0.0186	1.6328	0.07099
Nasiriyah	27.9	23	0.0436	3.5945	0.15627
Basra Al Hussein	28.36	23	0.0293	2.3762	0.10332
ELAM	23.85	23	0.0113	1.0898	0.04738
DezPHul	32.35	23	0.0377	2.6804	0.11654
BOstan	33.1	23	0.0731	5.0728	0.22056
Dehlran	32.3	23	0.1007	7.17564	0.31198

Source: The researcher's work, based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Table (4) Surface data for a program RS.

Map (5) the rate of change in the maximum temperatures of the study stations for the period (1996-2019).

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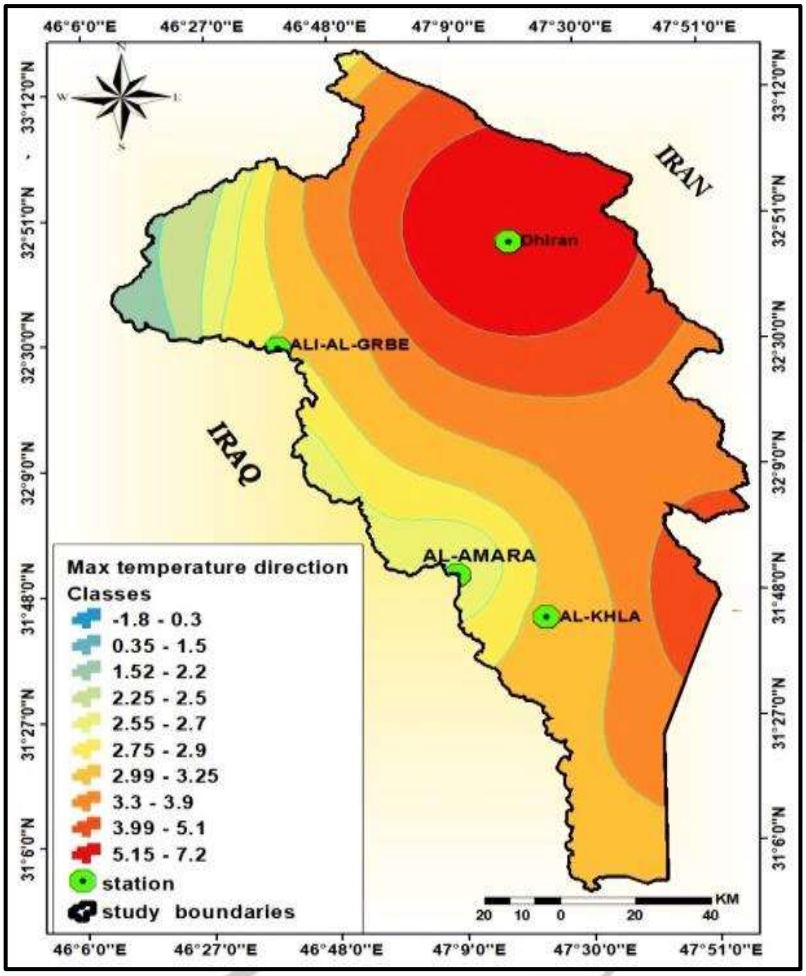

Source/researcher's work based on GIS Arc Map 10.8, Table (4) Surface data for a program RS

Figure (10) The rate of change in the maximum temperatures of the study stations for the period 1996-2019

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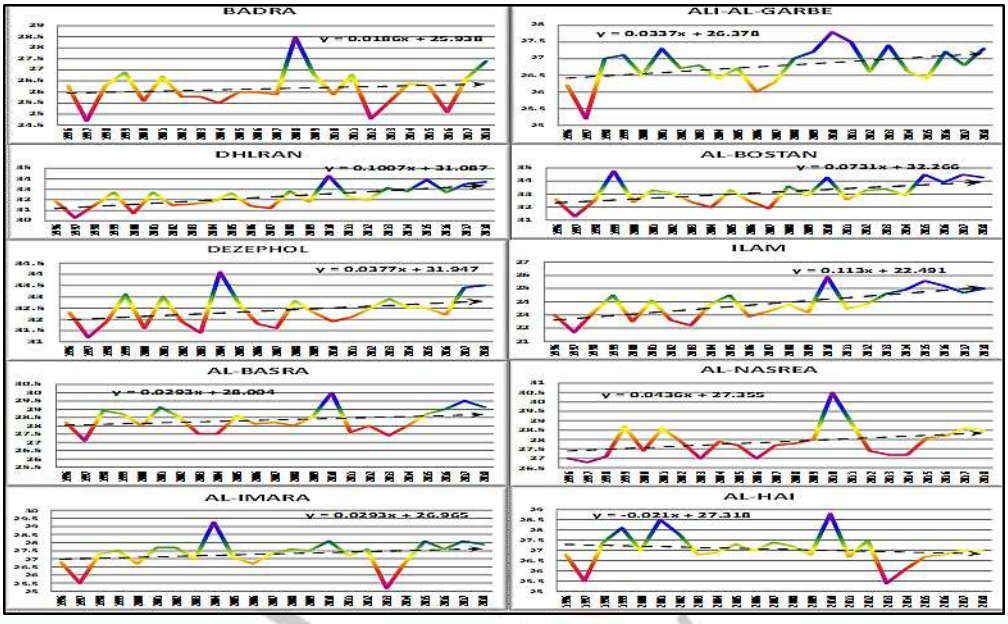
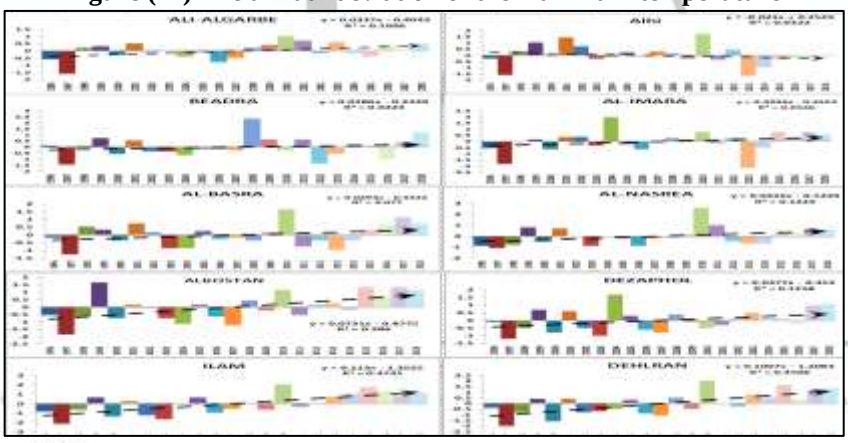


Source: The researcher's work, based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Table (4) Surface data for a program RS

Figure (11) The annual deviation of the maximum temperature



Source: The researcher's work, based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Table (4) Surface data for a program RS

1-12/ atmospheric pressure

It is clear from Table (5) that the general trend increased during the study period in all stations, and the increase rates ranged between (-0.01% and 0.3%) except for the stations Al-Amarah, Ali Al-Gharbi and Al-Hayy. See Table (5) and Map (6) and Figure (12),

Table (5) The rate of change of atmospheric pressure for the study stations for the period (1996-2019)

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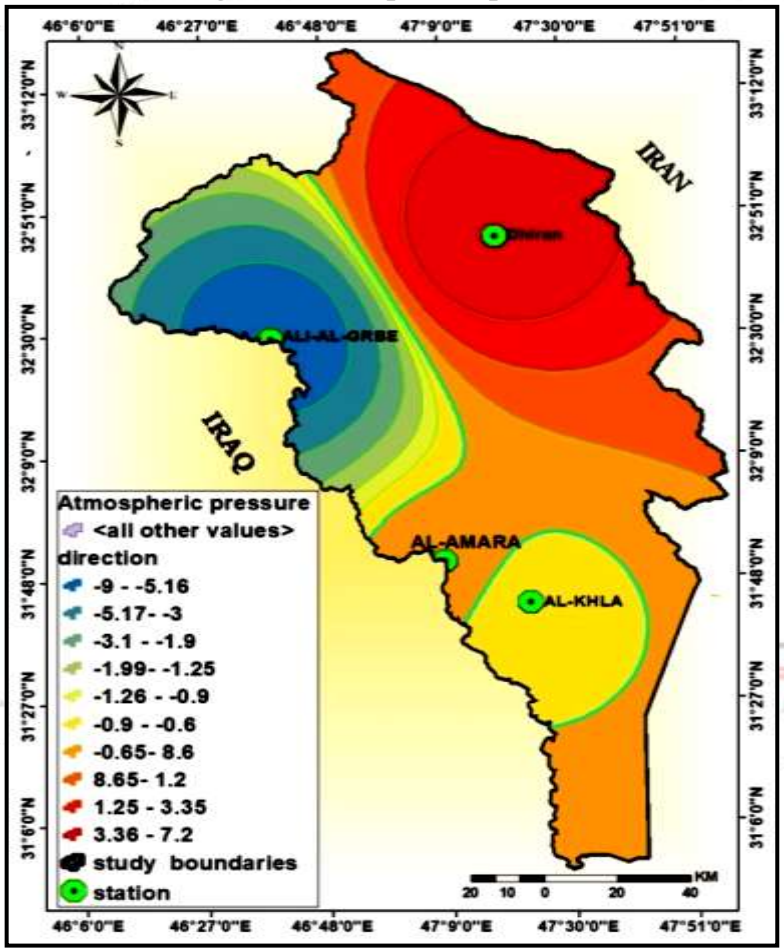
station	Average air pressure in hectopascals	The number of years	trend coefficient	(%) The rate of change for the study period	(%) Annual rate of change
BADRA	1014.8	23	0.0609	0.138	0.006
AL-AMARA	1015	23	0.0616-	0.1396-	0.0061-
Ali Al Gharbi	1013.6	23	0.3904-	0.8859-	0.0385-
AL-HAI	1015.9	23	0.0267-	0.0604-	0.0026-
Nasiriyah	1015.1	23	0.0078	0.0177	0.0008
Basra Al Hussein	1014.7	23	0.0062	0.0141	0.0006
ELAM	1016.4	23	0.0489	0.1107	0.0048
DezPHul	1012.3	23	0.1426	0.324	0.0141

. Source: The researcher's work is based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Surface data for a program RS

Map (6) the rate of change of atmospheric pressure for the study stations



Source/researcher's work based on GIS Arc Map 10.8 (Table 5) Surface data for a program RS

Figure (12) The rate of change of atmospheric pressure for the study stations for the period (1996-2019).

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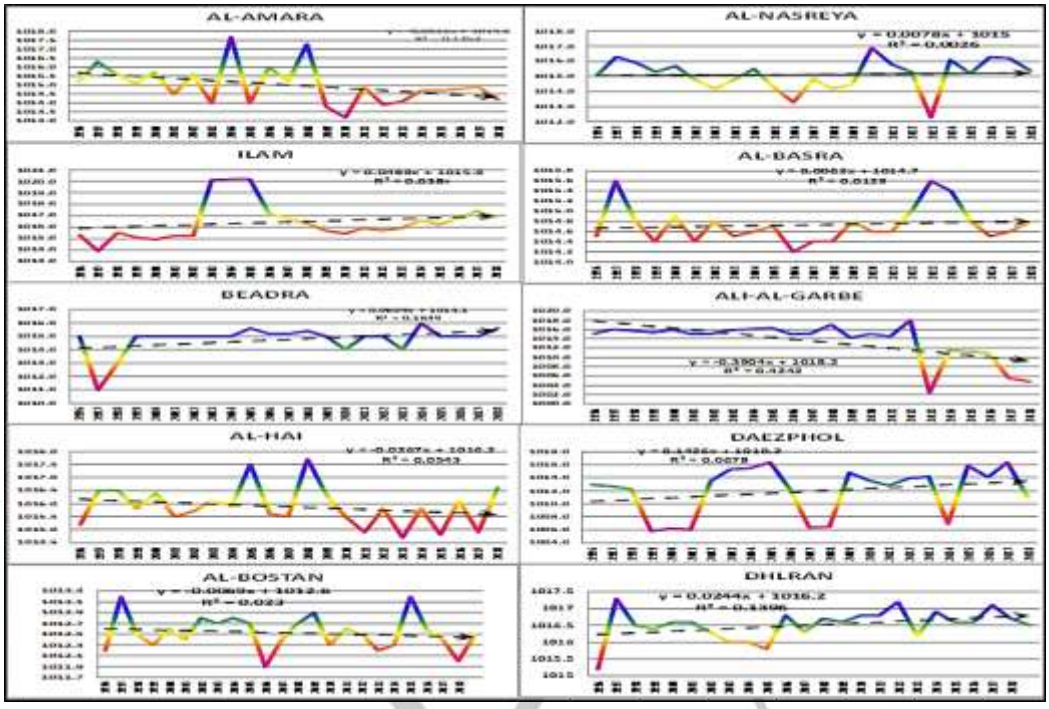

Source: The researcher's work, based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Table (5) Surface data for a program RS

1-13/ wind speed

It is evident from Table (6) that the direction of wind speed took a decreasing trend during the study period in most of the stations, and the rates of decrease ranged between (-0.1% and 57%) except for the stations of Basra, Ilam, Dezful, and Dehlran, see Table (6) and Map (7)) and figure (13)

Table (6) The rate of change and deviation of wind speed (m/sec) for the study stations for the period from ((1996-2019))

station	average wind speed m/s	The number of years	trend coefficient	(%) The rate of change for the study period	(%) Annual rate of change
Al-HAI	3.3	23	0.0438-	-30.5273	-1.3273
AL-AMARA	3.2	23	0.0563-	-40.4656	-1.7594
Ali Al Gharbi	3.5	23	0.0873-	-57.3686	-2.4943
BEDRA	2.7	23	0.0012-	-1.0222	-0.0444
Nasiriyah	3.2	23	0.0339-	-24.3656	-1.0594
Basra Al Hussein	3.8	23	0.02	12.1053	0.5263
ELAM	3.6	23	0.0301	19.2306	0.8361
DezPHul	3.9	23	0.0169	9.9667	0.4333
BOstan	3.1	23	0.029-	-21.5161	-0.9355
Dehlran	3.6	23	0.0301	19.2306	0.8361

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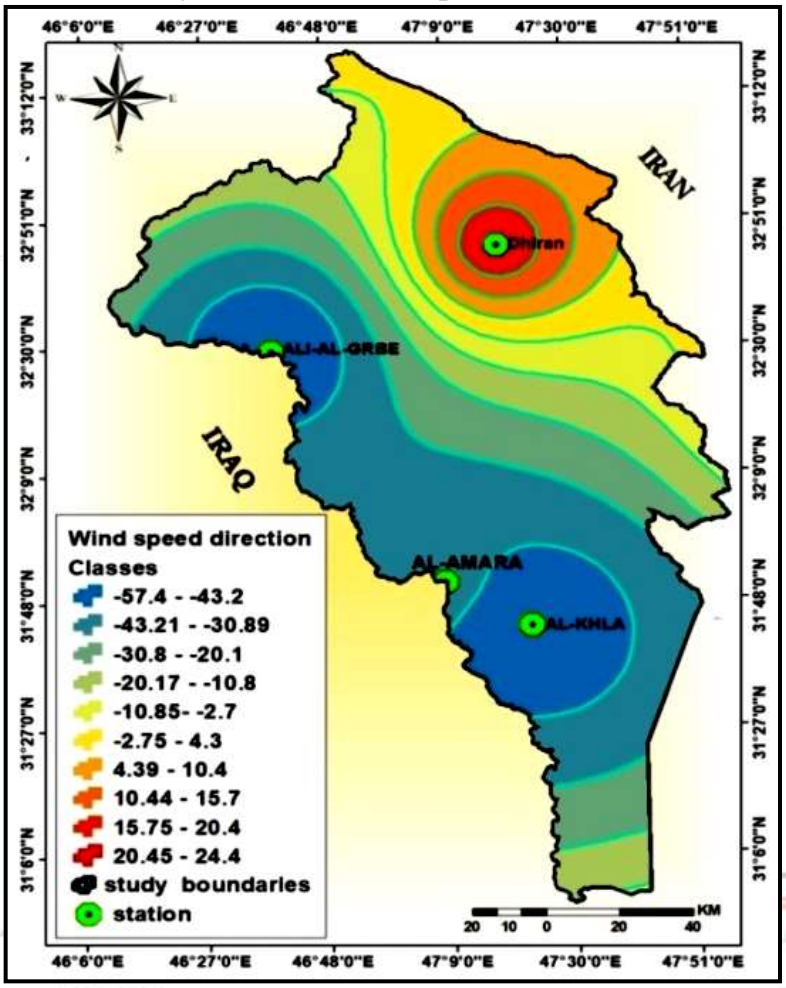
Source: The researcher's work is based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Surface data for a program RS

Map (7) The rate of change and deviation of wind speed (meters/second) for the study stations for the period from (1980)



Source/researcher's work based on GIS ArcMap 10.8, Table (6) Surface data for a program RS

Figure (13) The rate of change and deviation of wind speed (m/sec) for the study stations

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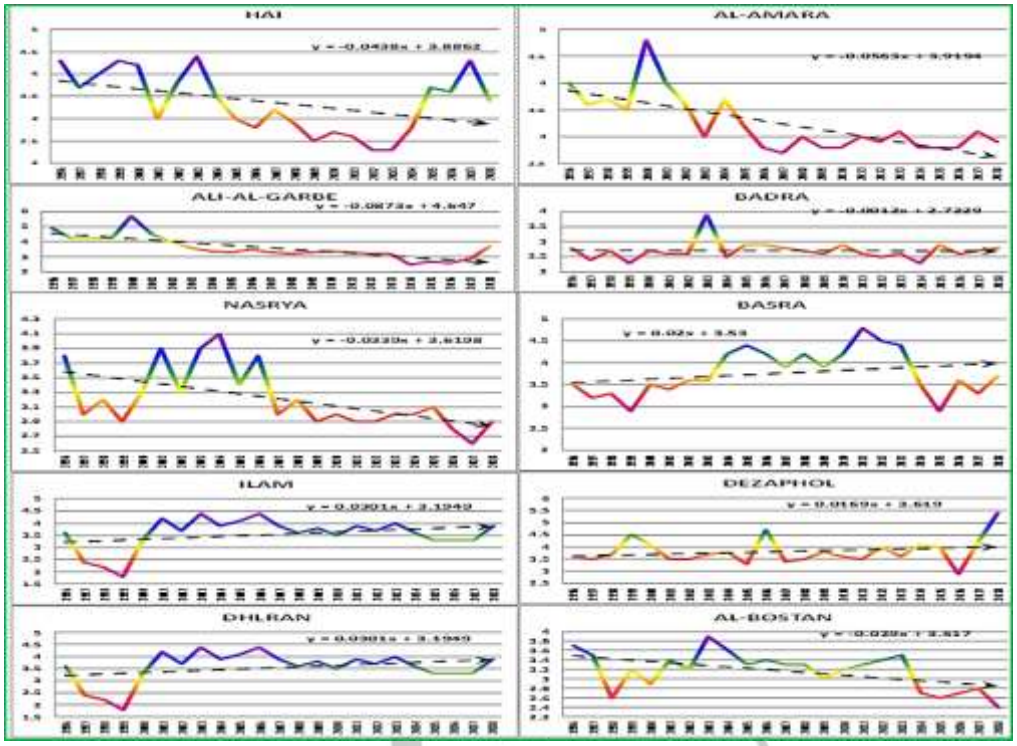

Source: The researcher's work, based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Table (6) Surface data for a program RS.

1-14 Relative Humidity

It is evident from Table (7) that the trend of relative humidity decreased during the study period in most of the stations, and the rates of decrease ranged between (-5% and 22%) except in Dehlran Ali Al-Gharbi and Al-Hai stations, see Table (7) and Map (8) and Figure. (14),

Table (7) The rate of change and deviation of relative humidity (%) for the study stations

(%) Annual Rate of Change	Rate of Change for Study Period	%	Trend Coefficient	Number of Years	Average Relative Humidity	Station
0.284489796	6.54	100	0.1394	23	49	AL-HAI
-0.255467197	-5.87	100	-0.1285	23	50.3	AL-EMARA
0.298843931	6.87	100	0.1551	23	51.9	ALI-GARBI
-0.552620545	-12.71	100	-0.2636	23	47.7	BADRA
-1.022417582	-23.51	100	-0.4652	23	45.5	AL-NASERYA
-0.662800875	-15.24	100	-0.3029	23	45.7	ALBASRA
-0.676109937	-15.55	100	-0.3198	23	47.3	ELAM

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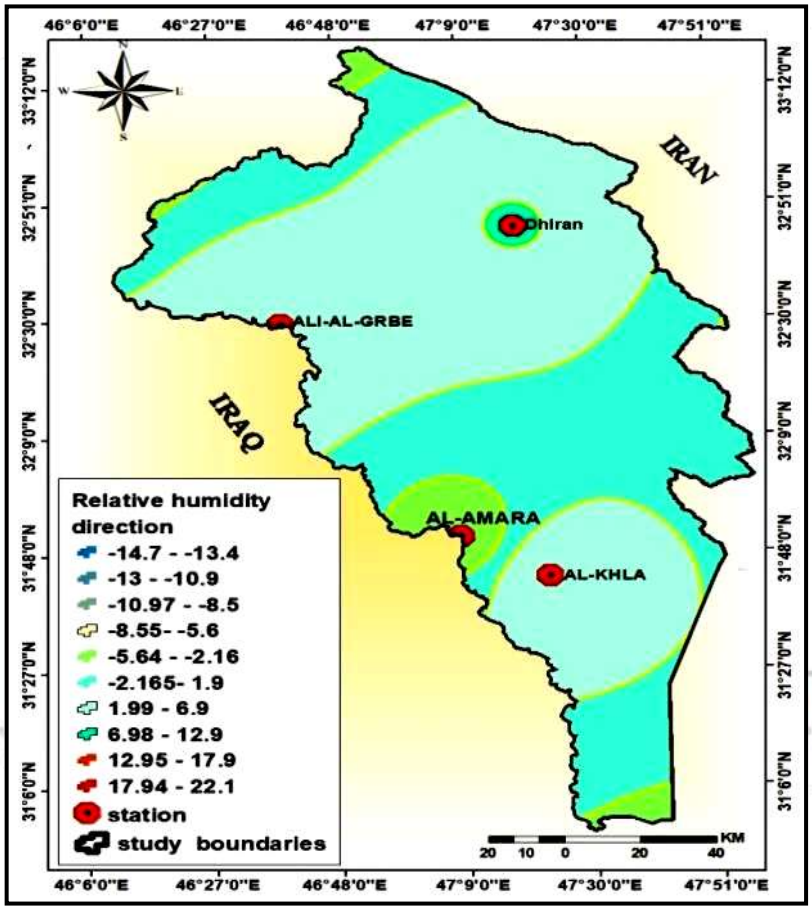
-0.270731707	-6.22	100	-0.1998	23	73.8	DYZFUL
-0.23125	-5.31	100	-0.1554	23	67.2	BUSTAN
0.336842105	7.74	100	0.1984	23	58.9	DHLRAN

Source: The researcher's work is based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Surface data for a program RS

Map (8) rate of change and deviation of relative humidity (%) for the study stations



Source/researcher's work based on GIS Arc Map 10.8, Table (7) Surface data for a program RS

Figure (14) The mean of change and deviation of relative humidity (%) for the study stations

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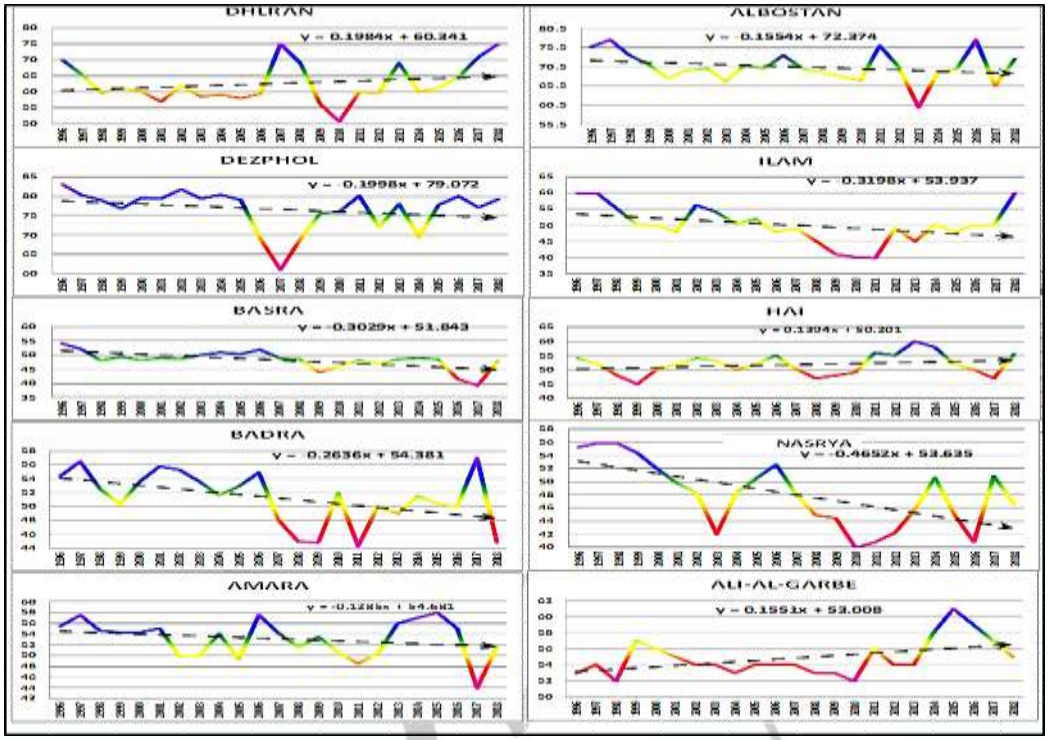

Source: the researcher's work, depending on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Table (7) Surface data for a program RS

1-15/ Rain change indicator

It is clear from Table (8) that the rain trend decreased during the study period in most stations, and the decreasing rates ranged between (-1% and -7.2%) except for the two stations of Amarah and Ilam. Figure (16) shows a downward trend in all study stations, indicating a decrease in the studied stations. Table (8), map (9), and Figure (15), (16).

Table (8): the rate of change of total rainfall (mm) for the study stations

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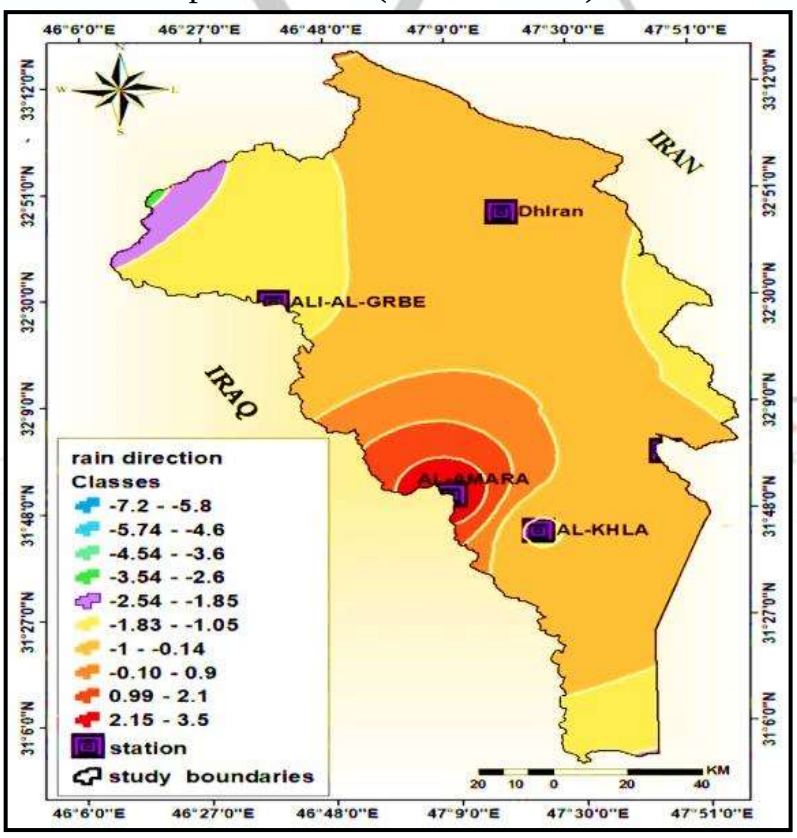
station	Total average rainfall m/sec	The number of years	trend coefficient	(%) The rate of change for the study period	(%) Annual rate of change
Al-HAI	522	23	1697-	7.2-	325.096-
AL-AMARA	452.7	23	0.2294-	1.1655-	0.05067-
Ali Al Gharbi	1037.5	23	1.5962	3.538564	0.153851
BEDRA	442.1	23	0.6192	3.221353	0.140059
Nasiriyah	282.6	23	0.3163-	2.57427-	0.11192-
Basra Al Hussein	291.2	23	0.0858-	0.67768-	0.02946-
ELAM	266.7	23	0.4135-	3.56599-	0.15504-
DezPHul	942	23	1.2164-	2.96998-	0.12913-
BOstan	666.2	23	0.2255-	0.77852-	0.03385-
Dehlran	492.3	23	0.1846-	0.86244-	0.0375-

Source: The researcher's work is based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Surface data for a program RS

Map (9) the rate of change of total rainfall (mm) for the study stations for the period from (1996 to 2019).



Source/researcher's work based on GIS Arc Map 10.8, Table (8) Surface data for a program **RS**

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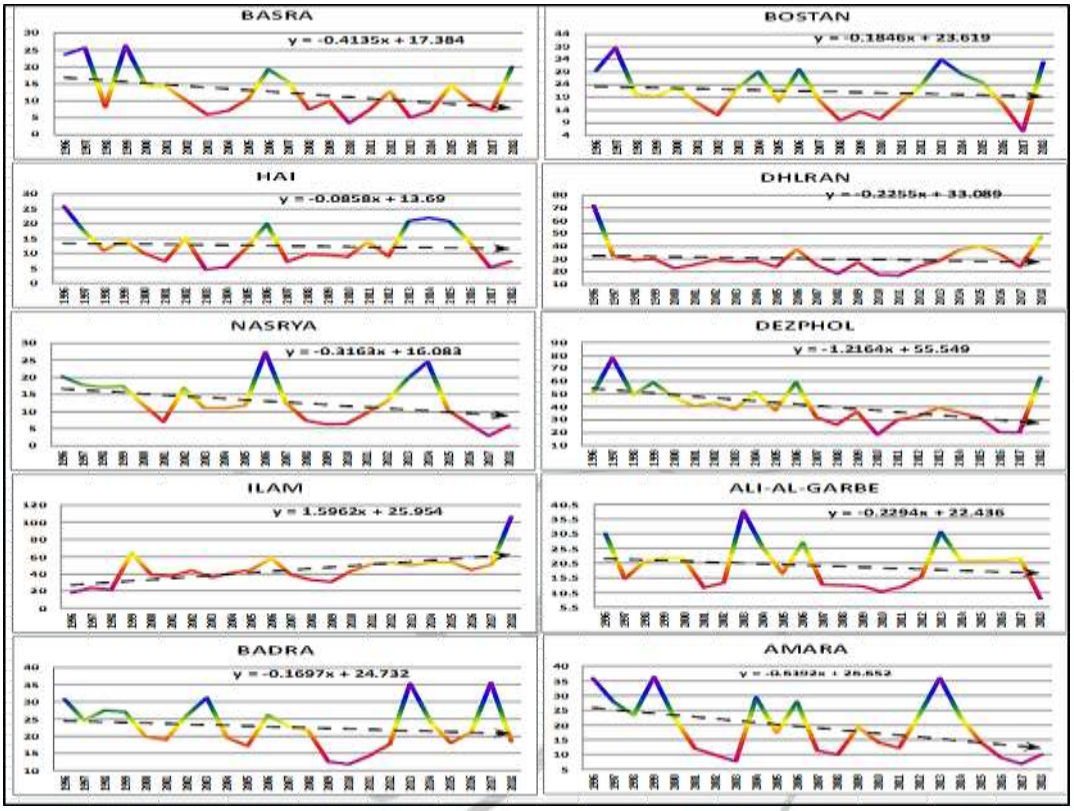
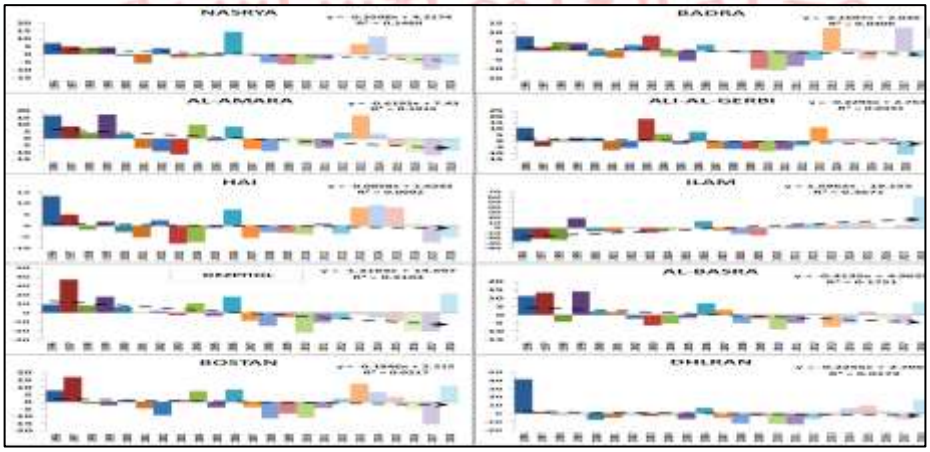
Figure (15) The rate of change of total rainfall (mm) for the study stations from 1996 to 2019.



Source: the researcher's work is based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Table (8) Surface data for a program RS

Figure (16) The rate of change of total rainfall (mm) for the study stations for the period from (1996 to 2019).



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Source: the researcher's work, depending on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Table (8) Surface data for a program RS

1-16/ Standard evaporation

Several factors affect the evaporation process, including the wind, the difference in atmospheric pressure, the size of the water body, the nature of the surrounding area, the movement of water, waves, and salts, high rates of temperature, the number of hours of brightness and an increase in the amount of radiation, which leads to an increase in evaporation from water bodies It is clear from Table (9) that the trend of standard evaporation took a decreasing trend during the study period in most of the stations, and the rates of decrease ranged between (-0.7% and 2.9%) see Table (9) and Figure (17),

Table (9) The rate of change and deviation of the quantities of standard evaporation (mm)

station	Sum standard evaporation rates mm	The number of years	trend coefficient	(%) The rate of change for the study period	(%) Annual rate of change
Al-HAI	3783.6	23	1.1058-	0.6722-	0.02923-
AL-AMARA	4520.8	23	1.8864-	0.95972-	0.04173-
Ali Al Gharbi	4249.5	23	5.2717-	2.85326-	0.12405-
BEDRA	3568	23	1.5921-	1.0263-	0.04462-
Nasiriyah	4262.6	23	0.5054	0.272702	0.011857
Basra Al Hussein	3858.8	23	1.1177-	0.66619-	0.02896-
ELAM	4946.2	23	0.0169	0.007859	0.000342
DezPHul	3307.704	23	1.0771-	0.74896-	0.03256-
BOstan	2365.6	23	0.8997	0.874751	0.038033
Dehlran	1900	23	0.9456	1.144674	0.049768

Source: The researcher's work is based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Surface data for a program RS

Map (10) of the rate of change and deviation of the quantities of standard evaporation (mm) for the study stations

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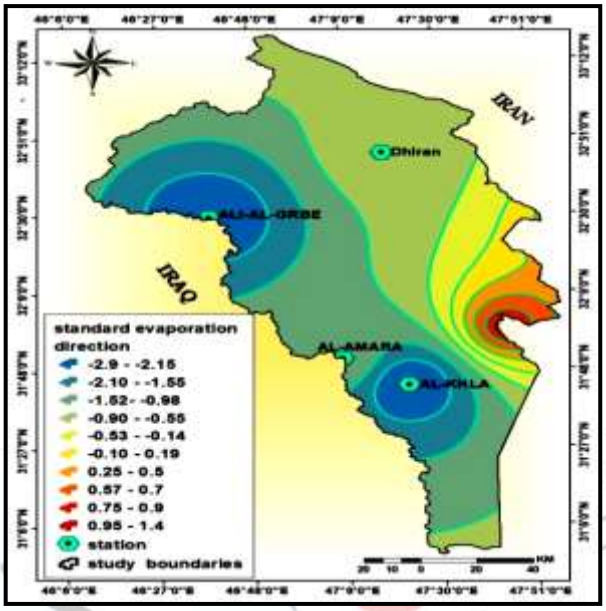
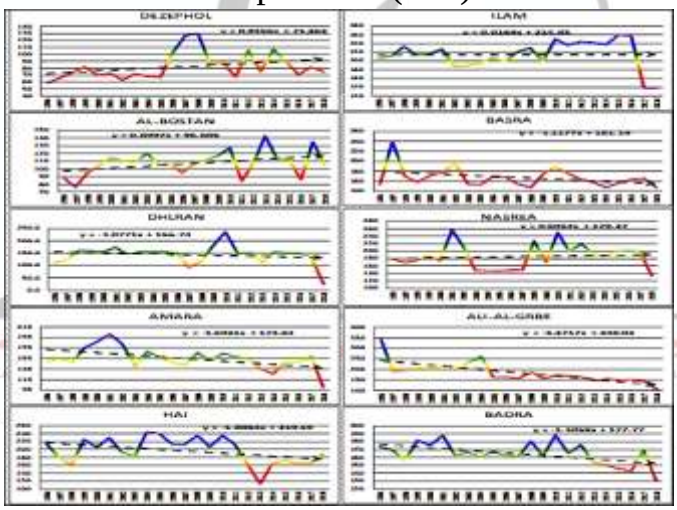


Source/researcher's work based on GIS Arc Map 10.8, Table (9) Surface data for a program RS

Figure (17) The rate of change and deviation of the quantities of standard evaporation (mm)



Source: the researcher's work, based on the General Authority for Meteorology and Seismic Monitoring, Climate Department, Baghdad, 2021 (unpublished data). Table (9) Surface data for a program RS

The second method is a statistical method of Campbell's curve and distribution for different precipitation periods starting (15-30-60-180-360-720-1440 during the rainy months). (M. Al Muhaimid. (2018) [Online]. Regional Factors for Calculating)

1-17Calculating the volume of floods in the study area

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The discharge density in the basins of the northern study valleys was (1.0208836) m3, while the discharge density of the central valleys was (0.910255) m3, while the discharge density of the southern group was (0.911296), and the total discharge density was (2.842435) m3, which indicates an increase in valley discharges and the occurrence of flood waves in the study area due to changes in climatic characteristics. (Outputs of the WMS program and the ARC map program) Depending on the amount of rain, the depths of the rain intensity were between (4-16) mm3 and their repetitions were (298) in the spring for the stations (Ali al-Gharbi, al-Kahla, Ilam, al-Bostan, Dehloran) that dominate the study area, while the level (17-50 mm3) was its repetitions during the study period (69), while the repetitions of the level were (51-180) mm3 (4) times, while the total frequency of rainfall intensity was between 4-180 mm3/hour (371) for the study years.

1-18 Result Discussion

We conclude through the study that climatic changes have affected after reviewing the research results, which appeared after studying the climatic elements. The trend of the final changes during 22 years showed a discrepancy in specific locations, including the Iranian stations, in particular Al-Bustan, Dezful, Dehlran, and Elam stations, while the stations were The Iraqi climate is less variableThe trend of minimum temperatures has taken an increasing direction during the study period in most stations, and the rates of increase ranged between (0.5% and 20.8%) except for the stations of Ilam, Basra and Badra.The rates of annual maximum temperatures have taken an increasing direction in all study stations,For rain, the rates of increase ranged between (+5.9 and +10.6) except for the station of Al-Hay,The rates of decrease ranged between (-1% and 7477%) except for the stations of Amara and Ilam Relative humidity.

1-19 Conclusions

1) The study area was exposed to severe changes above the average during the study period.
2) Iranian stations witnessed clear changes in all studied climatic elements.
3) The climatic stations in Iraq were characterized by positive regional changes, while most Iranian stations were characterized by negative climatic changes.
4) The study area witnessed extreme climatic conditions, especially in temperatures. Calculating the volume of floods in the study area 1. While the discharge continues in the basins of the northern study valleys (1.0208836) m3, while the discharge continues in the central study area (0.910255) m3, while the discharge continues in the central area (0.911296), and the total discharge reached (2.842435) m3, which indicates an increase in the discharges of the valleys and the flood study unit in the study due to climate changes rain.

1-20 Sources

[1] P. Katilaand S.Risto, "ADAPTATION OF FORESTS AND PEOPLE TO CLIMATE CHANGE – A Global Assessment Repor,". *IUFRO World Series* , Vol. 22, no1. Helsinki. pp7,8, 2018.

[2] WMO, "Statement on the State of the Global Climate in 2018. ," (WMO), World Meteorological Organization, (WMO)-No. 1233 © World Meteorological Organization, P6., 2019.

[3]]. M.Al-Saidi, "Global Climate Changes, Causes, Evidence, and Future Prospects," *Journal of the College of Basic Education*, , Vol. 21, No. 89, , pp. 201, 375, 2015.

[4] A. Sahib, ALI,and Muthanna]. A.Mousawi, "Climate Changes in the Atmosphere and Their Biological Effects on Living Organisms" *Journal of Geographical Research*, vol. 1'No. 11, pp. 16-17 , 2008.

[5] WMO The World Meteorological Organization, "statement on the state of the climate," , Publication No. 1130, pp. 4,6,8.(2013) No. 1130, pp. 4,6,8., 2013.

[6] EM-DAT CRED, "(International Disaster Database," 2021.

[7] A.Ghalis Nahi and A.Saeedi, *The Impact of Climate Change on Changing the Influential Totalitarian Systems in Iraq During the Rainy Season* , Basr: Geography Department,pp107-108. 2011.

[8] WMO., "Statement on the State of the Climate in2019 (WMO)," WMO., Publication No. 1248, pp. 6, 9, 18, 2019.

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[9] WMO, "World Meteorological Organization statement on the state of the climate in 2018," Publication No. 1233, p. 22, 2018.

[10] M. Ablain, "Satellite altimetry-based sea level at global and regional scales," *Surveys in Geophysics*, vol. 21, PP 38, 2017.

[11] UN., "World Heritage Convention, case studies on climate change," Augustin Colette, United Nations, United Nations, PP. 12,13, 2013.

[12] WMO, "World Meteorological Organization Statement on the State of the Climate in 2017," Publication No. 1233, pp. 9, 25, 29, 2017.

[13] Friedlingstein. (2019) Global Carbon Budget", Earth System Science Data. [Online]. https://doi.org/10.5194/essd-11-1783

[14] T. Mahmoud,and. M.Saeedi, *Climate Changes*, previous, pp. 390-391,2019.

[15] A. Al-Budairi.and A. Hamad, *Indicators of climate change and their impact on increasing the manifestations of drought in the province of Babylon*, Department of Geography, Ed. Baghdad: Ibn Rushd, 2012.

[16] The mean deviation (Md) is defined as the average of the sum of absolute deviations from their arithmetic mean, and is used to explain the deviations (of climate elements). It is extracted using the following equation

$$MD = \frac{\sum |x - \bar{x}|}{n}$$

Issa Ali Ibrahim, Statistical and Geographical Methods, Second Edition, Dar Al-Ma'rifah Al-Jami'iyah, Alexandria, 1999, p. 102.

[17] M. Al Muhaimid. Muhannad. (2018) (Campbell's Marginal Distribution), www.pdffactory.com. [Online]. Regional Factors for Calculating Rain Intensity" (Campbell's Marginal Distribution

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